Titan Scatterometry Rev 292

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- Sequence: s101
- Rev: 292
- Observation Id: ti_292_1
- Target Body: Titan

1 Introduction

This memo describes one of the Cassini RADAR activities for the s101 sequence of the Saturn Tour. A sequence design memo provides the science context of the scheduled observations, an overview of the pointing design, and guidelines for preparing the RADAR IEB. A 3-hour warmup occurs first using the parameters shown in table 3.

2 CIMS and Division Summary

CIMS ID	Start	End	Duration	Comments
292TI_WRMUP4ALT002_RIDER	2017-254T15:16:00	2017-254T20:33:00	05:17:0.0	
292TI_ALTIMETRY002_PIE	2017-254T20:33:00	2017-254T22:13:00	01:40:0.0	

Table 1: ti_292_1 CIMS Request Sequence

Each RADAR observation is represented to the project by a set of requests in the Cassini Information Management System (CIMS). The CIMS database contains requests for pointing control, time, and data volume. The CIMS requests show a high-level view of the sequence design.

The CIMS requests form the basis of a pointing design built using the project pointing design tool (PDT). The details of the pointing design are shown by the PDT plots on the corresponding tour sequence web page. (See https://cassini.jpl.nasa.gov/radar.) The RADAR pointing sequence is ultimately combined with pointing sequences from other instruments to make a large merged c-kernel. C-kernels are files containing spacecraft attitude data.

A RADAR tool called RADAR Mapping and Sequencing Software (RMSS) reads the merged c-kernel along with other navigation data files, and uses these data to produce a set of instructions for the RADAR observation. The RADAR instructions are called an Instrument Execution Block (IEB). The IEB is produced by running RMSS with a radar config file that controls the process of generating IEB instructions for different segments of time. These segments of time are called divisions with a particular behavior defined by a set of division keywords in the config file. Table 2 shows a summary of the divisions used in this observation. Subsequent sections will show and discuss the keyword selections made for each division. Each division table shows a set of nominal parameters that are determined by the operating mode (eg., distant scatterometry, SAR low-res inbound). The actual division parameters from the config file are also shown, and any meaningful mismatches are flagged.

Division	Name	Start	Duration	Data Vol	Comments
a	distant_warmup	00:00:0.0	05:18:0.0	18.9	Warmup
b	distant_radiometer	05:18:0.0	00:02:0.0	0.1	Radiometer quick-steps
c	distant_radiometer	05:20:0.0	00:08:12.0	0.5	Engineering Test off-target
d	distant_radiometer	05:28:12.0	00:04:48.0	0.3	Radiometer filler
e	scat_compressed	05:33:0.0	00:05:0.0	0.9	Scatterometer Compressed coming on target
f	distant_radiometer	05:38:0.0	00:08:12.0	0.5	Engineering Test on-target
g	distant_radiometer	05:46:12.0	00:00:6.0	0.0	Radiometer filler
h	scat_compressed	05:46:18.0	00:04:42.0	0.8	Scatterometer Compressed, saving data volue
i	scatterometer_imaging	05:51:0.0	00:09:0.0	110.7	high rate scatt on nadir point
j	scatterometer_imaging	06:00:0.0	00:10:0.0	121.2	high rate scatt on nadir point
k	scatterometer_imaging	06:10:0.0	00:10:0.0	120.0	high rate scatt on nadir point
l	scatterometer_imaging	06:20:0.0	00:03:0.0	35.1	high rate scatt on nadir point
m	scat_compressed	06:23:0.0	00:03:0.0	0.5	Scatterometer Compressed, saving data volue
n	distant_radiometer	06:26:0.0	00:08:12.0	0.5	Engineering Test on-target
o	distant_radiometer	06:34:12.0	00:00:6.0	0.0	Radiometer filler
p	scat_compressed	06:34:18.0	00:07:42.0	1.4	Scatterometer Compressed going off target
q	distant_radiometer	06:42:0.0	00:08:12.0	0.5	Engineering Test off-target
r	distant_radiometer	06:50:12.0	00:04:48.0	0.3	Closing Radiometer
Total				412.3	

Table 2: Division summary. Data volumes (Mbits) are estimated from maximum data rate and division duration.

Name	Nominal	Actual	Mismatch	Comments
mode	radiometer	radiometer	no	
start_time (min)	varies	0.0	no	
end_time (min)	varies	318.0	no	
time_step (s)	varies	5400.0	no	Used by radiometer only modes - saves commands
bem	00100	00100	no	
baq	don't care	5	no	
csr	6	6	no	6 - Radiometer Only Mode
noise_bit_setting	don't care	4.0	no	
dutycycle	don't care	0.38	no	
prf (Hz)	don't care	1000	no	
tro	don't care	0	no	
number_of_pulses	don't care	8	no	
n_bursts_in_flight	don't care	1	no	
percent_of_BW	don't care	100.0	no	
auto_rad	on	on	no	
rip (ms)	34.0	34.0	no	
max_data_rate	0.248	0.992	yes	Kbps - set for slowest burst period
interleave_flag	off	off	no	
interleave_duration (min)	don't care	10.0	no	

Table 3: ti_292_1 Div a distant_warmup block

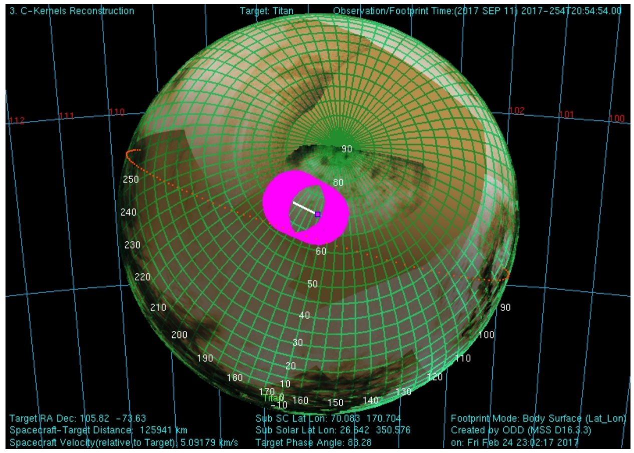

Figure 1: PDT view of TI 292 observation.

3 Overview

Like ti_275, this observation is a special long range nadir pointed observation designed to look for any bright specular points that also were observed in prior Arecibo observations. Figure 1 shows the location of the beam footprint during the active nadir pointing segment. Scatterometery mode is used to maximize SNR, and the long range requires 6 bursts in flight. The PRF is set to cover the doppler spread. Table 4 shows the parameters used during the active nadir pointing segment. Specialized processing similar to that used on active rings data collections will be needed for this data set.

This observation also has engineering tests just before and just after the primary nadir pointing observation. Each in turn has an engineering test positioned off-target and on-target to provide for better resolving of system gain and noise temperature variations. The engineering tests consist of a set of receive only collections that cycle through all four bandwidth modes and many of the most common attenuator settings used in the mission. In the configuration file, divisons c, f, n, and q are manually replaced by special segments similar to those used in prior engineering tests. The data volumes in table 2 are incorrect for these divisions because of the manual substitutions. These last four engineering tests will provide a look at the radar system gain and noise temperature performance at the end of mission.

4 Revision History

1. Apr 12, 2017: Initial Release

Name	Nominal	Actual	Mismatch	Comments
mode	scatterometer	scatterometer	no	
start_time (min)	varies	351.0	no	
end_time (min)	varies	360.0	no	
time_step (s)	varies	30.0	no	
bem	00100	00100	no	
baq	0	5	yes	5 - 8-8 for high range
csr	0	0	no	8 - auto gain
noise_bit_setting	4.0	4.0	no	Noise like setting for scatt
dutycycle	0.35	0.70	yes	maximize SNR
prf (Hz)	1000	3500	yes	cover doppler spread
tro	6	6	no	
number_of_pulses	100	50	yes	fitting inside limits
n_bursts_in_flight	1	6	yes	accomodating long range operation
percent_of_BW	100.0	100.0	no	
auto_rad	on	on	no	
rip (ms)	34.0	34.0	no	
max_data_rate	82.000	205.000	yes	highest possible
interleave_flag	off	off	no	
interleave_duration (min)	don't care	10.0	no	

Table 4: ti_292_1 Div i scatterometer_imaging block

5 Acronym List

ALT	Altimeter - one of the radar operating modes
BAQ	Block Adaptive Quantizer
CIMS	Cassini Information Management System - a database of observations
Ckernel	NAIF kernel file containing attitude data
DLAP	Desired Look Angle Profile - spacecraft pointing profile designed for optimal SAR performance
ESS	Energy Storage System - capacitor bank used by RADAR to store transmit energy
IEB	Instrument Execution Block - instructions for the instrument
ISS	Imaging Science Subsystem
IVD	Inertial Vector Description - attitude vector data
IVP	Inertial Vector Propagator - spacecraft software, part of attitude control system
INMS	Inertial Neutral Mass Spectrometer - one of the instruments
NAIF	Navigation and Ancillary Information Facility
ORS	Optical Remote Sensing instruments
PDT	Pointing Design Tool
PRI	Pulse Repetition Interval
PRF	Pulse Repetition Frequency
RMSS	Radar Mapping Sequencing Software - produces radar IEB's
SAR	Synthetic Aperture Radar - radar imaging mode
SNR	Signal to Noise Ratio
SOP	Science Operations Plan - detailed sequence design
SOPUD	Science Operations Plan Update - phase of sequencing when SOP is updated prior to actual sequencing
SSG	SubSequence Generation - spacecraft/instrument commands are produced
SPICE	Spacecraft, Instrument, C-kernel handling software - supplied by NAIF to use NAIF kernel files.
TRO	Transmit Receive Offset - round trip delay time in units of PRI